

WHAT IS CLAIMED IS:

1 1. A method of computing phase difference between a measured signal and a
2 reference signal, the method comprising:
3 measuring a first cycle of the measured signal to arrive at a first denominator;
4 measuring a first cycle of the reference signal to arrive at a second denominator;
5 calculating a time after the first cycle of the measured signal and a subsequent pulse
6 of a reference clock signal to arrive at a first numerator;
7 calculating a time after the first cycle of the reference signal and the subsequent pulse
8 of the reference clock signal to arrive at a second numerator;
9 dividing the first numerator by the first denominator to arrive at a first quotient;
10 dividing the second numerator by the second denominator to arrive at a second
11 quotient; and
12 deriving a difference between the first and second quotients to arrive at a first position
13 value, wherein the position value translates to a first phase difference.

1 2. The method of computing phase difference between a measured signal and a
2 reference signal of claim 1, the method further comprising:
3 computing a derivative of the first quotient over time to arrive at a first frequency
4 value.

1 3. The method of computing phase difference between a measured signal and a
2 reference signal of claim 2, the method further comprising:
3 correlating the first phase difference to the first frequency value in a lookup table.

1 4. The method of computing phase difference between a measured signal and a
2 reference signal of claim 1, the method further comprising:
3 calculating a time after the first cycle of the measured signal and a pulse following the
4 subsequent pulse of a reference clock signal to arrive at a third numerator;
5 calculating a time after the first cycle of the reference signal and the pulse following
6 the subsequent pulse of the reference clock signal to arrive at a fourth
7 numerator;
8 dividing the third numerator by the first denominator to arrive at a third quotient;

dividing the fourth numerator by the second denominator to arrive at a fourth quotient; and
deriving a difference between the third and fourth quotients to arrive at a second position value, wherein the second position value translates to a second phase difference.

5. The method of computing phase difference between a measured signal and a reference signal of claim 4, the method further comprising:
computing a derivative of the third quotient over time to arrive at a second frequency value.

6. The method of computing phase difference between a measured signal and a reference signal of claim 5, the method further comprising:
correlating the second phase difference to the second frequency value in the lookup table.

7. A method of computing time difference between a measured signal and a reference signal, the method comprising:
measuring a first cycle of the measured signal to arrive at a first denominator;
calculating a time after the first cycle of the measured signal and a subsequent pulse of a reference clock signal to arrive at a first numerator;
calculating a time after the first cycle of the reference signal and the subsequent pulse of the reference clock signal to arrive at a second numerator; and
deriving a difference between the first and second numerators to arrive at a first time difference value.

8. The method of computing time difference between a measured signal and a reference signal of claim 7, the method further comprising:
dividing the first numerator by the first denominator to arrive at a first quotient; and
computing a derivative of the first quotient over time to arrive at a first frequency value.

1 9. The method of computing time difference between a measured signal and a
2 reference signal of claim 8, the method further comprising:
3 correlating the first time difference value to the first frequency value in a lookup
4 table.

1 10. A method of computing phase difference between a measured signal and a
2 reference signal, the method comprising:
3 receiving the measured signal from a first receiver wherein the measured signal
4 provides a pulse on each cycle;
5 generating a reference clock signal and a measurement clock signal;
6 receiving the reference signal from a second receiver wherein the reference signal
7 provides a pulse on each cycle;
8 calculating a measurement denominator value based on a first pulse and a succeeding
9 second pulse of the measured signal wherein the value is calculated against the
10 measurement clock signal;
11 calculating a measurement numerator value based on the second pulse of the
12 measured signal and a next succeeding pulse of the reference clock signal;
13 deriving a measurement quotient value by dividing the measurement numerator value
14 by the measurement denominator value;
15 calculating a reference denominator value based on a first pulse and a succeeding
16 second pulse of the reference signal wherein the value is calculated against the
17 measurement clock signal;
18 calculating a reference numerator value based on the second pulse of the reference
19 signal and a next succeeding pulse of the reference clock signal;
20 deriving a reference quotient value by dividing the reference numerator value by the
21 reference denominator value; and
22 calculating a difference between the measurement quotient value and the reference
23 quotient value to arrive at a position value, wherein the position value relates a
24 phase difference.

1 11. The method of computing phase difference between a measured signal and a
2 reference signal of claim 10 further comprising:

3 deriving a derivative of the measurement quotient as a function of phase over time
4 and determining an operating frequency; and
5 relating the operating frequency to the phase difference.

1 12. The method of computing phase difference between a measured signal and a
2 reference signal of claim 11 further comprising:

3 storing the operating frequency and the phase difference in a lookup table.

1 13. A method of computing time difference between a measured signal and a
2 reference signal, the method comprising:

3 receiving the measured signal from a first receiver wherein the measured signal
4 provides a pulse on each cycle;
5 generating a reference clock signal and a measurement clock signal;
6 receiving the reference signal from a second receiver wherein the reference signal
7 provides a pulse on each cycle;
8 calculating a measurement denominator value based on a first pulse and a succeeding
9 second pulse of the measured signal wherein the value is calculated against the
10 measurement clock signal;
11 calculating a measurement numerator value based on the second pulse of the
12 measured signal and a next succeeding pulse of the reference clock signal;
13 deriving a measurement quotient value by dividing the measurement numerator value
14 by the measurement denominator value;
15 calculating a reference numerator value based on the second pulse of the reference
16 signal and a next succeeding pulse of the reference clock signal;
17 calculating a difference between the measurement numerator value and the reference
18 numerator value to arrive at a time difference value.

1 14. The method of computing time difference between a measured signal and a
2 reference signal of claim 13 further comprising:
3 deriving a derivative of the measurement quotient as a function of phase over time
4 and determining an operating frequency; and
5 relating the operating frequency to the time difference value.

1 15. The method of computing time difference between a measured signal and a
2 reference signal of claim 14 further comprising:
3 storing the operating frequency and the time difference in a lookup table.

1 16. An optical measurement system comprised of:
2 an optical receiver outputting a measured signal having a clock cycle;
3 a reference receiver outputting a reference signal having a clock cycle;
4 a system clock signal; and
5 a measurement clock signal, wherein
6 the clock cycle of the measured signal and the clock cycle reference are
7 calculated against the measurement clock signal,
8 the beginning of the second cycle of the measured signal is timed to a next
9 subsequent pulse of the system clock signal and divided by the clock
10 cycle of the measured signal to arrive at a first vector phase value;
11 the beginning of the second cycle of the reference signal is timed to the next
12 subsequent pulse of the system clock signal and divided by the clock
13 cycle of the reference signal to arrive at a second vector phase value;
14 and
15 the difference between the first and the second vector phase values is
16 calculated to arrive at a first position value.

1 17. The optical measurement system of claim 16 further comprised of:
2 a frequency converter, wherein the frequency converter converts the first vector phase
3 to a first frequency value.

1 18. The optical measurement system of claim 17 further comprised of:
2 a lookup table wherein the first position value is correlated to the first frequency
3 value.

1 19. The optical measurement system of claim 18 further comprised of:
2 a memory in the optical receiver wherein the lookup table resides.

1 20. The optical measurement system of claim 16 wherein
2 the beginning of the second cycle of the measured signal is timed to a
3 subsequent pulse of the next pulse of the system clock signal and
4 divided by the clock cycle of the measured signal to arrive at a third
5 vector phase value;
6 the beginning of the second cycle of the reference signal is timed to the next
7 subsequent pulse of the next pulse of the system clock signal and
8 divided by the clock cycle of the reference signal to arrive at a fourth
9 vector phase value; and
10 the difference between the third and fourth vector phase values is calculated to
11 arrive at a second position value.

1 21. The optical measurement system of claim 20 further comprised of:
2 a frequency converter, wherein the frequency converter converts the third vector
3 phase to a second frequency value.

1 22. The optical measurement system of claim 21 further comprised of:
2 a lookup table, wherein the second position value is correlated to the second
3 frequency value.

1 23. The optical measurement system of claim 21 further comprised of:
2 a memory in the optical receiver wherein the lookup table resides.
3

1 24. An optical measurement system comprised of:
 2 an optical receiver outputting a measured signal having a clock cycle;
 3 a reference receiver outputting a reference signal having a clock cycle;
 4 a system clock signal; and
 5 a measurement clock signal, wherein
 6 the clock cycle of the measured signal and the clock cycle reference are
 7 calculated against the measurement clock signal,
 8 the beginning of the second cycle of the measured signal is timed to a next
 9 subsequent pulse of the system clock signal to arrive at a first time
 10 value and
 11 divided by the clock cycle of the measured signal to arrive at a vector
 12 phase value;
 13 the beginning of the second cycle of the reference signal is timed to the next
 14 subsequent pulse of the system clock signal to arrive at a second time
 15 value; and
 16 the difference between the first and the second time values is calculated to
 17 arrive at a time difference value.

1 25. The optical measurement system of claim 24 further comprised of:
 2 a frequency converter, wherein the frequency converter converts the vector phase to a
 3 frequency value.

1 26. The optical measurement system of claim 25 further comprised of:
 2 a lookup table wherein the time difference value is correlated to the frequency value.

1 27. The optical measurement system of claim 26 further comprised of:
 2 a memory in the optical receiver wherein the lookup table resides.